Technical Report 710

Performance of Soldiers on the Battlesight Tank Gunnery Video Game

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Research Institute for the Behavioral and Social Sciences

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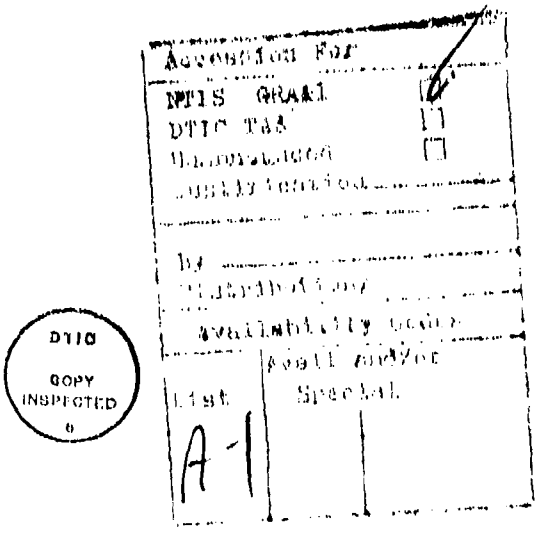

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The purpose of this research was to examine practice effects on a tank gunnery video game in a series of three experiments. Number of hits and number of first-round-hits were collected over trials in Experiments 1 and 2. Based on duty position, subjects were divided into experienced and inexperienced groups in both Experiments 1 and 2. The experienced groups consisted of Tank Commander/Gunners and the inexperienced groups were Driver/Loaders. Subjects used the gunner's primary sight in Experiment 1 and the gunner's secondary sight in Experiment 2. Significant improvement was found in the (Continued)

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number of hits and the number of first-round-hits over practice trials in both Experiments 1 and 2. No differences were found between the experienced and inexperienced groups in the first two experiments. Subjects' accuracy and speed were examined over trials under two different game formats and two different target kill zones in Experiment 3. Accuracy was measured by the percentage of hits and the percentage of first-round-hits. Speed was measured by the average time to fire, which was computed by dividing the elapsed game time by the number of rounds of ammunition fired. The game formats were (a) the standard video game with three lives and 60 rounds of ammunition, and (b) a revised format that equally distributed the three lives and 60 rounds of ammunition into three separate games. A rectangle totally surrounding a threat tank represents the kill zone, i.e., a round of ammunition hitting in the rectangle destroys the target. The kill zone was reduced from 100% of the rectangle (standard kill zone) to 50% of the rectangle (reduced kill zone), which greatly decreased the vulnerable area around a target. Results of Experiment 3 indicated that the reduced kill zone groups were significantly less accurate than the standard kill zone groups. Improvement in accuracy was demonstrated when subjects used the revised video game format. No improvement was found when subjects used the standard game format. Improvement in the average time to fire was found for all groups.

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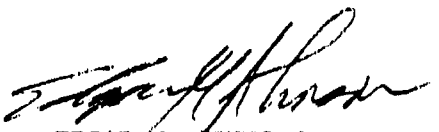
FOREWORD

The Fort Knox Field Unit of the Army Research Institute for the Behavioral and Social Sciences (ARI) has been conducting research on the effectiveness of part-task trainers and simulators. Due to the rising costs of equipment and ammunition, inexpensive means of training and sustaining proficiency levels of crewmen's tank gunnery skills have been developed. Before these devices are procured for use in the Army training environment, the potential positive and negative attributes of the devices should be examined.

This report describes the results of a research project designed to examine the training value of a prototype arcade-style tank gunnery game, the Battlesight. Skill acquisition involves speed and accuracy, which are both critical in tank gunnery. The learning curves, defined by speed and accuracy, are examined under varying experimental conditions in a series of three experiments. The results of this research should facilitate further investigation on the use of video games as training media.



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PERFORMANCE OF SOLDIERS ON THE BATTLESIGHT TANK GUNNERY VIDEO GAME

EXECUTIVE SUMMARY

Requirement:

The objectives of this research were (a) to specify the learning curves, defined by accuracy, when subjects used the gunner's primary sight and the gunner's secondary sight on a prototype tank gunnery video game, and (b) to examine subjects' speed and accuracy within different video game configurations.

Procedure:

Number of hits and number of first-round hits were collected over trials for experienced and inexperienced groups in Experiments 1 and 2. The experienced groups were Tank Commander/Gunners, and the inexperienced groups were Driver/Loaders. The learning curve was specified in Experiment 1 when subjects used the gunner's primary sight over 10 trials. Subjects used the gunner's secondary sight over four trials in Experiment 2. In Experiment 3, soldiers' accuracy and speed were examined over three trials under two different game formats and two different target kill zones. The game formats were (a) the standard video game with three lives and 60 rounds of ammunition, and (b) a revised game format with equal distribution of the three lives and 60 rounds of ammunition into three separate games. A rectangle surrounding a threat tank represents the target kill zone. At 100% the threat tank is destroyed by hitting anywhere within that rectangle. At 50%, the rectangle is decreased by one-half, which greatly reduces the area in which a hit destroys a threat target. The target kill zones were set at 100% for the standard kill zone, and 50% for the reduced kill zone. Analysis of variance and trend analysis were used to examine group differences and practice effects in all three experiments.

Findings:

Significant improvement was found in number of hits and number of first-round hits over practice trials in Experiments 1 and 2. No significant differences were found in performance between the experienced and inexperienced groups in the first two experiments. Both groups improved when subjects used the gunner's primary sight and the gunner's secondary sight. Results of Experiment 3 indicated a significant difference in accuracy between the standard kill zone and reduced kill zone groups, with the reduced kill zone groups being less accurate overall. For the revised video game groups, subjects' accuracy improved. No improvement was indicated for groups that used the standard game format. Improvement was found for all groups in the average time to fire.

Utilization of Findings:

The results of this research could be used as the basis for further examination of video games as training media. Because practice effects were demonstrated on the Battlesight tank gunnery game in both Experiments 1 and 2, the transfer of training issue should be explored. The lack of significant differences in performance between experienced and inexperienced subjects may be the result of the small sample sizes. The results of Experiment 3 suggest that the configuration of a video game can affect the game's training effectiveness. Performance of subjects in the reduced kill zone groups highlights a continual preoccupation with speed. Their speed significantly improved while their accuracy continued to suffer. Research into the detrimental effects of massed practice may be related to the attenuated accuracy of subjects in the groups using the standard video game format. A subject may emphasize speed over accuracy in the standard video game format because the massing of lives and ammunition lowers the emphasis on accuracy. On the other hand, the distribution of lives and ammunition, as represented by the revised video game format, may have forced equivalent emphasis on speed and accuracy. Therefore, accuracy improves along with speed. Consequently, a standard video game format may be highly motivating and yet not be appropriate in maintaining positive training value.

PERFORMANCE OF SOLDIERS ON THE BATTLESIGHT TANK GUNNERY VIDEO GAME

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INTRODUCTION

The development of inexpensive yet effective means of acquiring and sustaining proficiency levels of crewmen's tank gunnery skills has high priority in Army research. Because of the rising cost of equipment and ammunition, training devices and simulators are being utilized as means of supplementing live fire exercises. One such device, the Battlesight tank gunnery game, was developed through the cooperative efforts of the Defense Advanced Research Projects Agency (DARPA) and the Army Research Institute (ARI) for use by Armor crewmen in barracks dayrooms and leisure areas. The Battlesight models a single-player video game found in many commercial arcades. The appealing nature of a video game format was employed to increase crewmen's gunnery practice. Limited programmability allows the suppressing or altering of several Battlesight parameters. For example, game play can be programmed for either the M60A1 tank gunner's primary sight (M32E periscope) used in the normal mode or the secondary sight (M105D telescope) used in the degraded operational mode. Examples of these sights are in Appendixes A and B. Characteristics of the Battlesight game, such as the realistic reticle (sight) simulation and the mirroring of crewmen's tank gunnery skills required for game play, have generated considerable interest in the potential training value of this device.

Little research has been conducted concerning the use of video games in skill acquisition. Skill acquisition involves two main components, speed and accuracy. In standard video games, similar to the Battlesight, the avoidance of being destroyed by shooting first requires the subject to demonstrate speed. Video games allot a predetermined number of lives per game play and the loss of a life occurs when the subject's vehicle or weapon system has been destroyed. Thus, many video games subtly emphasize speed of response (Jones, Kennedy & Bittner, 1980). Accuracy is measured in video games by the destruction of objects, e.g. threat targets, which is reflected in the subject's overall game score. Improvement in a subject's game score as the number of games increases has been indicated in video game research (Jones, Kennedy & Bittner, 1980; Kennedy, Bittner & Jones, 1980). However, this improvement or increase may not reflect a true improvement or increase in the subject's accuracy. Several factors may contribute to this: (a) the game score usually does not account for the amount of "ammunition" consumed, (b) ammunition is often in abundant supply and (c) the subject is not usually penalized for misses. Consequently, the game score could be viewed as an inflated indicator of the subject's accuracy. These factors, coupled with the pressure of shooting first, may force the subjects to concentrate on speed at the expense of accuracy. An emphasis on accuracy, along with speed,may be achieved if scoring systems accounted for these factors.

A research report by Hoffman and Melching (1983), on the effectiveness of a tank gunnery simulator, the MK-60, suggested that even in simulators specifically designed for training, subjects may also be concerned with speed at the expense of accuracy. They found a decrease in time for achieving

target hits suggesting improvement in the speed of response with practice. However, no decrease was noted in the number of rounds expended per target kill. Therefore, no improvement in accuracy was evident. The MK-60 device supplies the subject with an abundant supply of ammunition for obtaining target kills within a limited time period. Subjects may have been less concerned with accuracy because of the abundant ammunition supply and the emphasis on allotted time. The results of this research indicate that training devices, whether video games or other devices, should be designed to stress improvement in accuracy as well as in the speed of response.

If speed and accuracy are major considerations in the skill acquisition process, then another factor which should be evaluated is the distribution of practice over time. Massed practice is the practicing of some skill over repeated trials without rest whereas distributed practice is the spacing of practice trials with periods of rest. Research on motor skills reports attenuated performance effects when the massed practice approach is used while distributed practice leads to heightened performance (Deese, 1958; Duncan, 1951; Gagne & Fleishman, 1959; Kientzle, 1946). Fatigue and information overload are two factors possibly responsible for the observed decrements in performance when massed practice is used. Crawford (1947) found an increase in target hit percentage when ammunition was distributed over several training missions. When the ammunition was fired in a single session (massed practice), the percent target hits declined. The massed practice model could be analogous to the video game format of supplying several lives and an abundant ammunition supply within one game. For example, one life could be considered one trial. If several lives are allowed for game play, then several repeated trials without rest would occur in the practice sequence. Therefore, the massing of lives and ammunition in video games may increase speed at the expense of accuracy while the distribution of lives and ammunition into separate games may increase accuracy as well as speed.

A useful advantage of video games is their apparent intrinsic motivational characteristic. An activity is intrinsically motivating if people engage in the activity voluntarily for self-satisfaction without expectation of external reward. Children's and adults' attraction toward video games has resulted in research concerning their instructional value. Malone (1981) and Bobko, Bobko and Davis (1984) suggested two ways of examining video games. Malone discussed the intrinsically motivating characteristics of computer games which could be incorporated into instructional systems. Bobko et. al. investigated the various dimensions of video games and people's game preferences.

Malone (1981) suggested three characteristics of highly motivating computer games: challenge, fantasy and curiosity. According to Malone, a challenging game should have goals which are personally meaningful and yet contain uncertain outcomes. A game is not challenging if individual success or failure is immediately perceived due to the game's difficulty level. For example, a game that is relatively easy to master is not challenging, nor is a game challenging that is exceedingly difficult for the person's mental or physical status. The second characteristic, fantasy, involves mental images of either physical objects or social situations not immediately present in

reality such as a game of piloting an aircraft and avoiding threat objects. A person's curiosity is stimulated "by providing an optimal level of informational complexity," (Malone, 1981, p. 362). Therefore, an optimally complex environment "will be one where the learner knows enough to have expectations about what will happen, but where these expectations are sometimes unmet." (Malone, 1981, p.362) In general, curiosity is the motivation to learn more in order to make the person's knowledge more "complete, consistent and parsimonious." (Malone, 1981, p.362).

Bobko, et. al. (1984) suggested that video games vary along three dimensions: destructiveness, dimensionality and graphics. The destructiveness dimension varies from a proactive or offensive strategy to a reactive or defensive strategy required for game play. Subjects in this research rated the destructiveness dimension as the most salient dimension. The proactive strategy refers to the destruction of opponents or threat objects in order to continue game play and score points. The avoidance of opponents or threat objects to continue game play is a reactive strategy. Bobko's subjects were equally divided on their preference for game strategy type. He suggested that personality characteristics may affect a person's preference for either strategy. For example, a person with an external locus of control may prefer reactive games while a person with an internal locus of control may prefer proactive games. People who perceive themselves as in control of life events have an internal locus of control. On the other hand, people with an external locus of control perceive life events as being determined by factors beyond their control.

The dimensionality category refers to "the number of physical dimensions (on the video screen) in which the player can maneuver" (Bobko, et.al., 1984, p. 479). Dimensionality represents the complexity of game play. One dimensional movement is the capability of a subject's gun or ship to move in only one direction whether right to left or up and down and corresponds to the simplest form of dimensionality. Two-dimensional movement is movement in two directions, by left-right and up-down, simultaneously. Three-dimensional movement includes the visual perception of depth along with left-right and up-down movement. Three-dimensional movement is the most complex form of dimensionality. The preferred game was located on a continuum between the two- and three-dimensional game groupings. This placement represents a preference for a moderate level of complexity in vidoo games. Bobko et. al. related this preference to the optimal level in theories of motivation. The optimal level refers to that level of complexity that is maximally arousing for optimal human performance. Research in motivation indicates that a moderate level of complexity is the optimal level. This preferred moderate level of complexity may be similar to Malone's (1981) definition of a challenging computer game where a challenging game presents an optimal level of difficulty for the person's mental and physical status.

The graphics dimension of video games refers to the degree of color vibrancy and resolution. Games which lack color, i.e., are black and white, and lack feature resolution are located at one end of the graphics dimension, while the preferred games, those which have high color vibrancy, i.e., colors

like reds and blues, and high graphic resolution, are located at the opposite end. The preference of color graphics over black and white graphics has been demonstrated in research on CRT displays. (Tullis, 1981)

The Battlesight appears to satisfy the requirements of an intrinsically motivating instructional system while at the same time containing the preferred components of a video game. The Battlesight is characterized by a high degree of challenge, fantasy and curiosity. The game scenario consists of proactive destruction, two- to three-dimensional movement and high quality graphic resolution and vibrancy using computer-generated imagery. These characteristics suggest the potential training value of the Battlesight. However, the possible negative consequences of using video games in the over-learning of inappropriate skills should not be overlooked. For example, the emphasis on speed and an abundant ammunition supply may undermine the increase in accuracy which is a critical component of tank gunnery skill acquisition. Capitalizing on the motivational aspect of a video game to increase the amount of voluntary gunnery practice should not concurrently compromise the instructional purpose of a training device. On the other hand, a video game that is intrinsically motivating while preserving appropriate training techniques would be an asset to an instructional system.

Purpose

The purpose of this research is to examine practice effects on the Battlesight tank gunnery game in a series of three experiments. Differences in number of target hits ascribed to amount of practice and amount of gunnery experience are investigated in both Experiments 1 and 2. Because experience affects gunnery performance and the Battlesight is a tank gunnery game, experience level is examined as a possible factor in subjects' performance on the Battlesight. Subjects use the gunner's primary sight in Experiment 1 and they use the gunner's secondary sight in Experiment 2. Percent hits (accuracy) and percent first-round-hits (accuracy) and the average time to fire (speed) are examined in four different Battlesight game configurations in Experiment 3. Experiment 3 involves the differences in subjects' performance over trials between the standard video game format with the massing of lives and ammunition in a single game versus a revised format with the distribution of lives and ammunition into separate games. Performance is also examined when the target kill zone is reduced. These manipulations allow the investigation of massed versus distributed practice and size of target kill zone on subjects' speed and accuracy.

EXPERIMENT 1

The learning curve was determined in Experiment 1 for number of hits and number of first-round-hits on a tank gunnery video game. All subjects used the gunner's primary sight and fired 50 rounds of ammunition per trial. The relationship between performance and level of experience was examined.

Method

Subjects. The subjects were 12 tank crewmen from K Company, 2nd Squadron, 6th Cavalry at the Armor Center, Fort Knox, Kentucky. Subjects were assigned to experienced and inexperienced groups. The experienced group (Group 1) consisted of six Tank Commander/Gunners and the inexperienced group (Group 2) consisted of six Driver/Loaders. The mean time in service for Group 1 was 79.1 months and mean rank was E-5. The mean time in service for Group 2 was 20.7 months and mean rank was E-3.

Apparatus. The Battlesight is a prototype arcade-style tank gunnery trainer. Battlesight specifications model the M60A1 tank which includes the gunner's controls (cadillacs) consisting of a magnetic brake palm switch for traversing the turret and a trigger switch for firing the main gun: (See Figure 1.) The Battlesight is also equipped with an automated tank commander who issues fire commands and slews the turret for target acquisition. The player interacts solely through the gunner's controls. No other switches or controls are provided on this version.

In the default/game mode, the player is allocated three lives and 63 rounds of ammunition. One of three Player Experience Levels (PEL) is chosen before game initiation, i.e., Novice, Qualified or Expert. The player begins the game in Stage I. The player advances through three increasingly difficult stages of game play by destroying all the threat tanks allocated to each stage. The stage of game play and the player experience level determine: (a) the number of allocated threat tanks, (b) the maximum number which are active at one time, and (c) the target speed. At the beginning of Stage 2 and Stage 3, the Player Experience Level will either be retained, lowered to the next level or increased to the next higher level depending upon the player's performance in the preceding stage. The player has two objectives: destroy as many threat tanks as possible with a minimum amount of ammunition and avoid being hit by the threat tanks thus losing a life. The game ends when the player has exhausted his supply of ammunition or has been hit three times by the enemy.

The Battlesight game display is a 19-inch (diagonal), three color cathode ray tube (CRT) which provides two display areas: the sight picture and the information area. The sight picture, an 11-inch diameter circle, models the gunner's M32E periscope or the gunner's M105D telescope. Computer generated imagery produces a battlefield which is viewed through either sight. The battlefield is randomly populated with Soviet T-62 tank animations at ranges between 1100 and 5000 meters. The animations can be stationary or they can be moving behind and around cultural objects such as trees and houses. The tank animations can also assume defilade or partial defilade positions. The

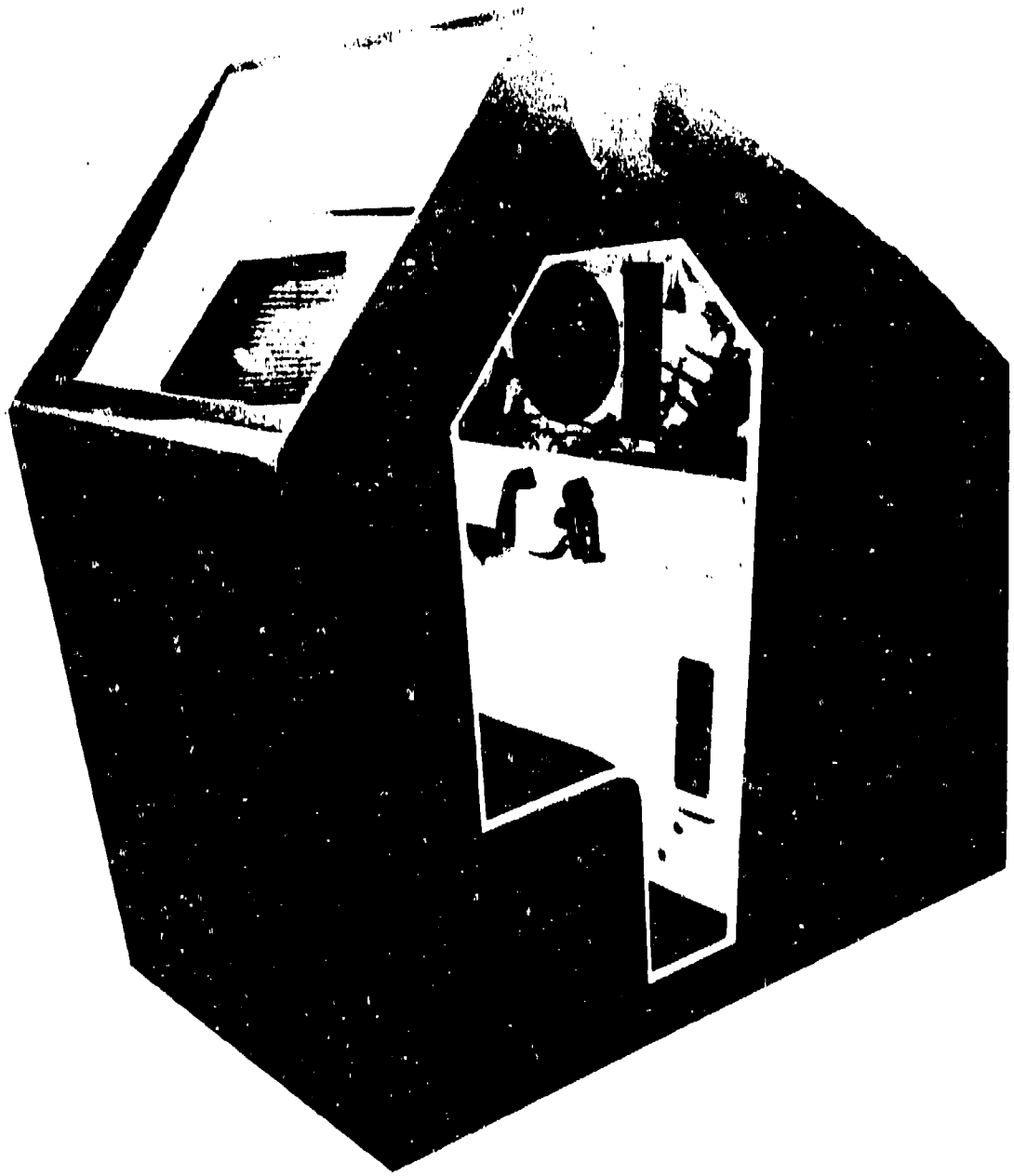

Figure 1. Gunner's controls on the Battlesight tank gunnery game.

information area, located to the right of the sight picture, provides the following information: (a) target location through a radar-type device, (b) time elapsed during game play, (c) the subject's score, (d) rounds of ammunition remaining and (e) number of lives remaining. The radar-type display represents the 1X power gunner's unity window of the M60A1 tank. Colored dots appear on the radar display which represent the gross location of threat tanks and their ranges. A "V" is superimposed upon this display and when the dots are positioned within the "V", the targets are within the subject's sight picture.

Experimental Design. The experimental design was a 2 x 10 repeated measures design, with two levels of experience and ten trials.

Procedure. Each subject participated in a two-day research project to assess performance when subjects used the M32E primary sight. Day 1 consisted of six trials with 50 rounds of ammunition expended per trial. Before beginning Trial 1, the subject listened to taped instructions explaining the Battlesight game play. (See Appendix C for transcript of instructions.) A 15-minute break was allowed after firing every 100 rounds of ammunition. A biographical questionnaire was completed by all subjects during the first break. Day 2 consisted of four more trials identical to the procedure during Day 1. Total number of possible hits equaled 50 per trial. A data collector tallied the total number of hits and first-round-hits during the firing of each 100 rounds. The Battlesight parameters were programmed to provide: (a) immortality (threat tanks could engage but not kill the subject's tank), (b) use of only Stage I and the "qualified" Player Experience Level to eliminate individual differences related to game stage and PEL, (c) no bonus ammo as a result of performance, (d) a four-second reload time, (e) 100 rounds of ammunition to fire before a break and (f) 100 threat tanks to engage. The automatic slew was disabled to force the subject to traverse the battlefield and acquire targets by following directions in the computer-generated fire command.

Results

Analysis of variance on repeated measures was performed to determine if level of experience had a significant effect on the number of hits and number of first-round-hits. No significant differences were found between the two groups for number of hits or first-round-hits. See Tables 1 and 2 for summary data. There was no significant group by trial interaction for number of hits or first-round-hits. Because the equality of the variance -covariance matrices could be questioned, the conservative F test with reduced degrees of freedom was used to test the trial effect on number of hits and number of first-round-hits. Results indicated an overall significant trial effect (F (1,10) = 11.285; $p<.01$) for number of hits and a significant positive linear trend in number of hits across trials (F (1,10) = 39.109; $p<.001$), see Figure 2. An overall significant trial effect was also found for number of first-round-hits (F (1,10) = 11.489; $p=.01$) with a significant positive linear trend in first-round-hits across trials (F (1,10) = 33.392; $p<.001$), see Figure 3.

Table 1

Mean number of hits for Experiment 1

Group[a]		Trial 1	2	3	4	5	6	7	8	9	10	Trial Mean
Experienced												
	M	29.33	32.33	36.00	32.83	33.83	34.33	37.00	38.50	39.33	40.50	35.38
	SD	6.25	4.13	5.14	6.24	7.08	7.00	7.40	5.61	5.32	4.32	4.75
Inexperienced												
	M	27.00	29.83	34.00	27.67	34.83	34.67	33.83	37.00	39.17	39.33	33.73
	SD	4.82	5.95	6.32	5.68	4.54	3.08	5.12	1.67	3.19	4.59	2.62
Total Sample												
	M	28.17	31.08	35.00	30.25	34.33	34.50	35.42	37.75	39.25	39.92	34.56
	SD	5.46	5.05	5.59	6.30	5.69	5.16	6.29	4.03	4.18	4.29	3.76

[a] n = 6 per group

Table 2

Mean number of first-round-hits for Experiment 1

Group[a]	Trial 1	2	3	4	5	6	7	8	9	10	Trial Mean
Experienced											
M	20.67	23.17	28.17	23.83	26.33	28.33	29.83	33.33	34.67	35.67	28.40
SD	7.84	6.59	7.83	7.86	7.89	10.01	10.91	7.03	8.24	6.41	6.57
Inexperienced											
M	18.17	21.33	26.17	19.83	26.33	27.33	26.50	30.00	33.00	33.50	26.25
SD	5.42	7.39	8.89	5.19	5.96	4.23	7.15	3.16	2.45	6.77	3.13
Total Sample											
M	19.42	22.25	27.17	21.83	26.33	27.83	28.17	31.67	33.83	34.58	27.33
SD	6.56	6.74	8.05	6.69	6.67	7.35	8.96	5.48	5.86	6.39	5.04

[a] *n* = 6 per group

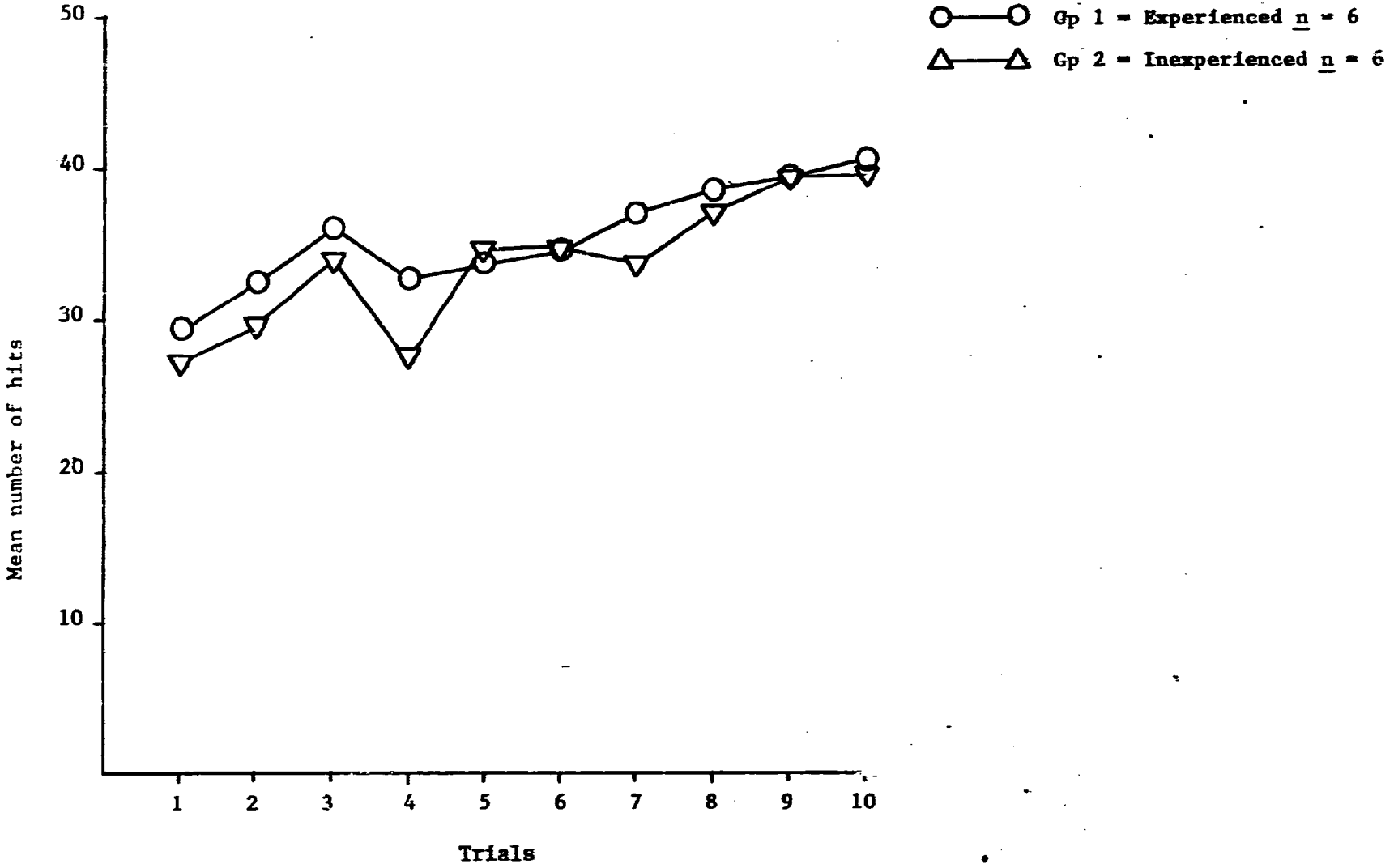

Figure 2. Mean number of hits per trial for Experiment 1.

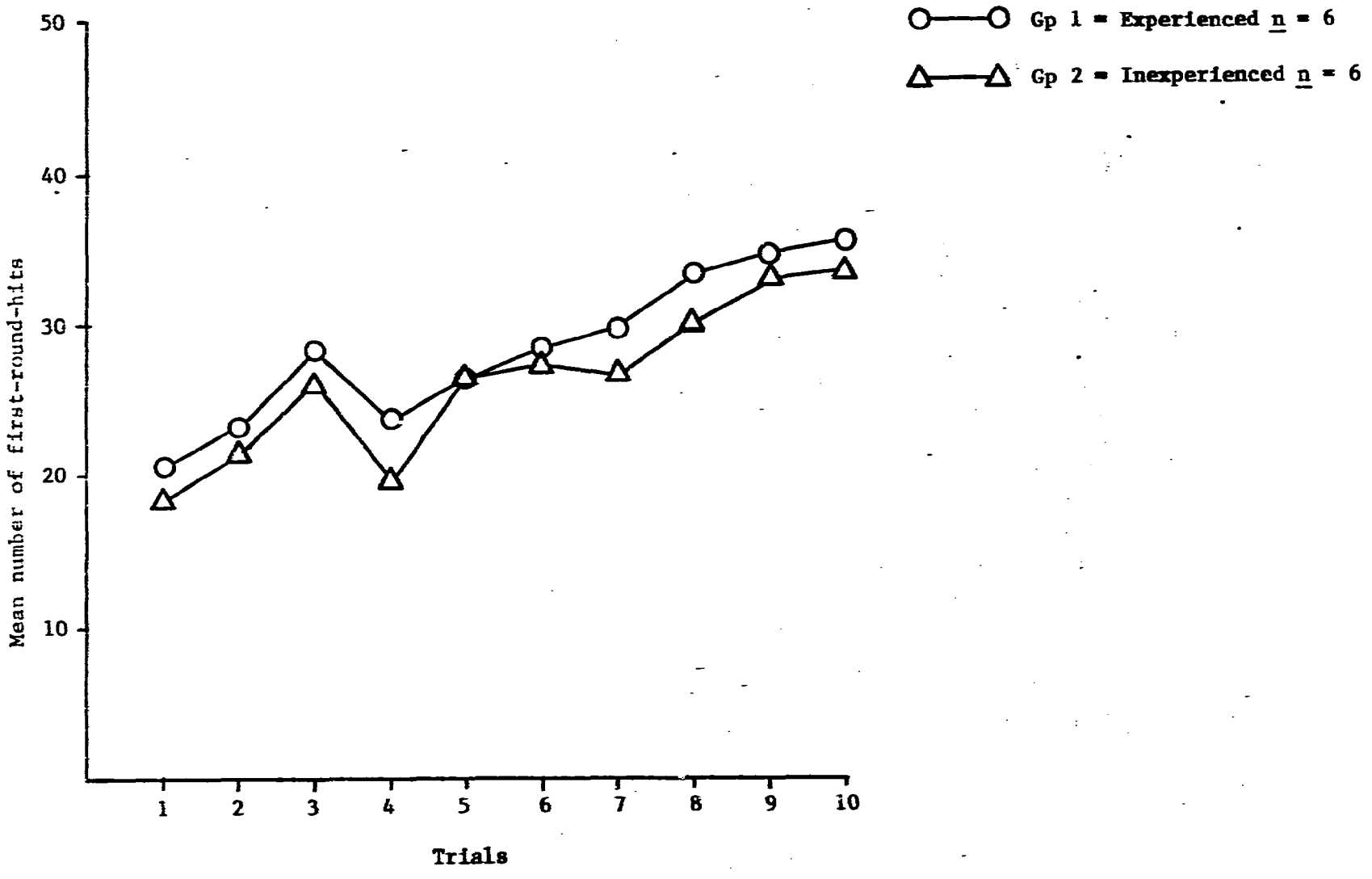

Figure 3. Mean number of first-round-hits per trial for Experiment 1.

Discussion

The purpose of this experiment was to evaluate number of hits and number of first-round-hits across trials for two groups of subjects with differing levels of experience. For a device to be an effective training aid, performance improvement should be indicated. The results suggest that learning did occur for these subjects with a positive linear increase in total number of hits and total number of first-round-hits across trials. Therefore, practice on the Battlesight tank gunnery game leads to improvement in subjects' performance associated with a typical learning curve. Although Figures 2 and 3 suggest possible differences in performance between the two groups on number of hits and first-round-hits, these differences were not statistically significant. The small sample size, n=6 per group, may have attenuated any significant differences.

EXPERIMENT 2

The learning curve was specified in Experiment 2 for number of hits and number of first-round-hits on a tank gunnery video game. All subjects used the gunner's secondary sight and fired 50 rounds of ammunition per trial. Performance between two groups with differing levels of experience was examined.

Method

Subjects. The subjects were 12 tank crewmen from K Company, 2nd Squadron, 6th Cavalry at the Armor Center, Fort Knox, Kentucky. The subjects were assigned to groups according to experience. Group 1 consisted of six Tank Commander/Gunners and Group 2 consisted of six Driver/Loaders. The mean time in service for Group 1 was 57.3 months and mean rank was E-5. For Group 2, the mean time in service was 14.7 months and mean rank was E-3.

Apparatus. The Battlesight tank gunnery game was used in Experiment 2. See Experiment 1 for details concerning the characteristics and operation of the Battlesight.

Experimental Design. The experimental design was a 2 x 4 repeated measures design, with two levels of experience and four trials.

Procedure. Each subject participated in a single session research project to assess subjects' performance when using the M105D secondary sight. The subject listened to taped instructions explaining the Battlesight game play before beginning the session. (See Appendix C for transcript of instructions.) Before beginning trial 1, the subject fired 100 rounds of ammunition using the M32E primary sight for familiarization with the device. This familiarization was to prevent the confounding of device characteristics with performance on the secondary sight. The subject then completed a biographical questionnaire. The session consisted of four trials with 50

rounds of ammunition expended per trial. A 15-minute break was allowed after firing 100 rounds of ammunition. The remaining portion of the procedure was identical to the procedure for Experiment 1.

Results

Analysis of variance on repeated measures was performed to determine if level of experience had a significant effect on number of hits and number of first-round-hits. No significant differences were found between the two groups for total number of hits or first-round-hits. See Tables 3 and 4 for summary data. An overall significant trial effect was found for number of hits and first-round-hits (F (3,30) = 5.799; $p<.01$ and F (3,30) = 7.411; $p<.001$ respectively), see Figures 4 and 5. A significant positive linear trend over trials was found for total hits and first-round-hits (F (1,10) = 16.182; $p<.01$ and F (1,10) = 14.974; $p<.01$ respectively). A significant group by trial interaction for number of hits was indicated (F (3,30) = 3.385; $p<.05$) with a significant quadratic trend (F (1,10) = 6.869; $p<.05$). There was no significant group by trial interaction for number of first-round-hits.

The simple effects of trial within group were found for number of hits. Significant trial effects were found for both groups (F (3,30) = 5.791; $p<.01$ for Group 1 and F (3,30) = 3.393; $p<.01$ for Group 2). However, the trend analysis indicated differing components in the trends of the trial means for each group. For Group 1, the linear and quadratic components were significant (F (1,10) = 8.817; $p<.05$ and F (1,10) = 5.789; $p<.05$ respectively). For Group 2, only the linear component was significant (F (1,10) = 7.396; $p<.05$).

Discussion

The purpose of Experiment 2 was to determine the number of hits and number of first-round-hits over trials for two groups of subjects with differing levels of experience. Subjects used the gunner's M105D secondary sight. Soldiers usually receive less training on the secondary sight because it is only used in the degraded operational mode when the gunner's primary sight is inoperable. Therefore, a device that could positively supplement training would be beneficial. For example, if soldiers could improve their gunnery skills on the secondary sight by increasing their amount of practice on the device, the device would be a positive training aid. Although Figures 4 and 5 suggest possible group differences in performance, these differences were not statistically significant. The insignificant group effect may have resulted from the small sample size, n=6 per group. However, the differing components of the trends of the trial means indicated a different learning curve for each group. A significant linear trend was found for both groups. The additional quadratic component for the experienced group may have resulted from fatigue. The decrement in performance which caused the quadratic trend for the experienced group occurred during the last 50 rounds of ammunition of the total 100 rounds fired before a break was permitted. The

Table 3

Mean number of hits for Experiment 2

	Trial					
	Pre-training	1	2	3	4	Trial Mean
Group[a]						
Experienced						
M	32.33	25.17	21.83	26.67	29.50	25.79
SD	4.96	2.79	4.92	6.22	5.09	3.91
Inexperienced						
M	29.50	19.17	23.67	23.50	24.67	22.75
SD	4.44	3.71	4.89	5.43	4.46	3.84
Total Sample						
M	30.92	22.17	22.75	25.08	27.08	24.27
SD	4.72	4.43	4.77	5.81	5.21	4.02

[a] n = 6 per group

Table 4

Mean number of first-round-hits for Experiment 2

	Trial					
Group[a]	Pre-training	1	2	3	4	Trial Mean
Experienced						
M	24.50	16.00	13.33	19.00	20.50	17.21
SD	6.53	3.03	4.80	6.23	6.53	4.36
Inexperienced						
M	20.67	9.83	14.17	14.50	16.83	13.83
SD	6.03	4.96	4.96	4.85	3.25	3.60
Total Sample						
M	22.58	12.92	13.75	16.75	18.67	15.52
SD	6.32	5.07	4.67	5.82	5.28	4.20

[a] n = 6 per group

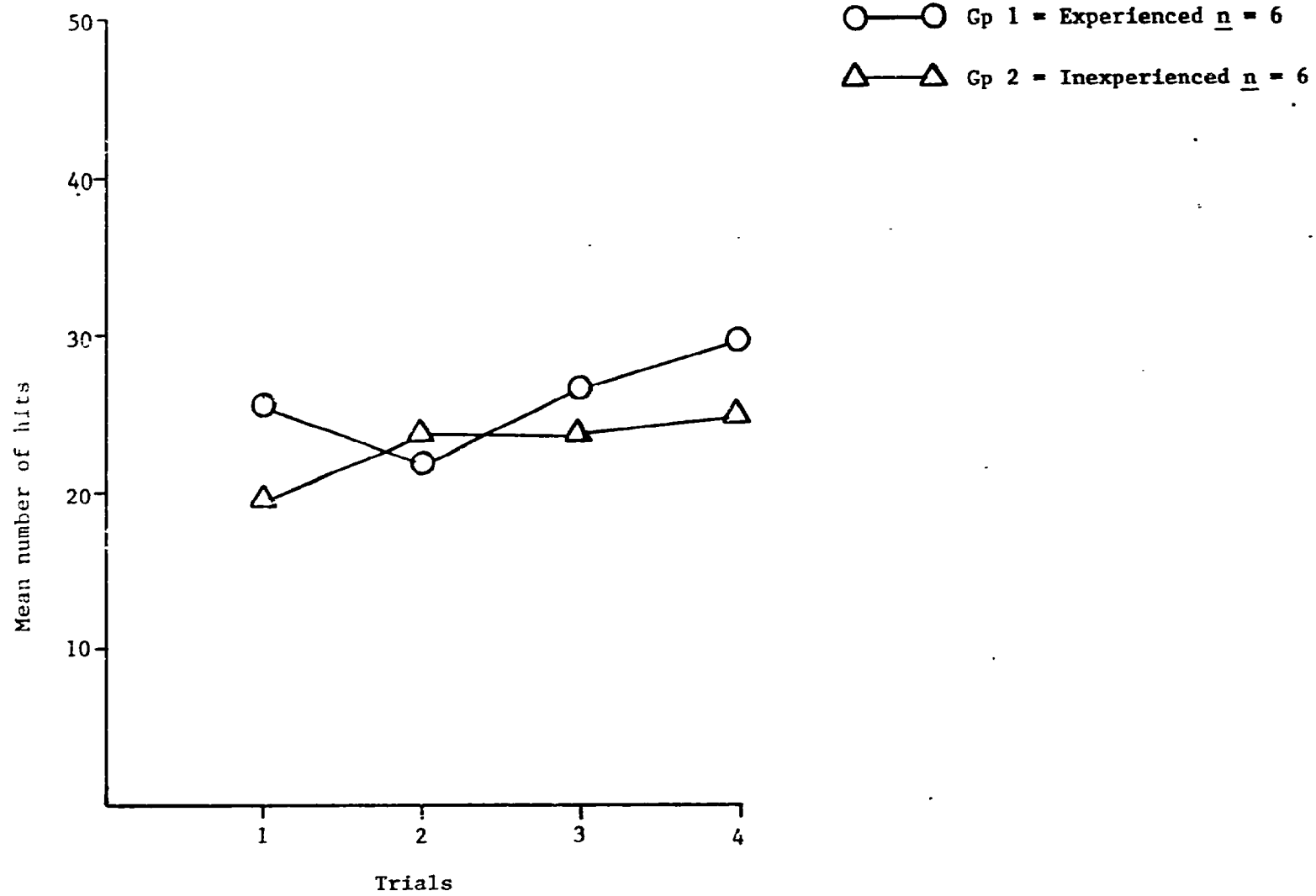

Figure 4. Mean number of hits per trial for Experiment 2.

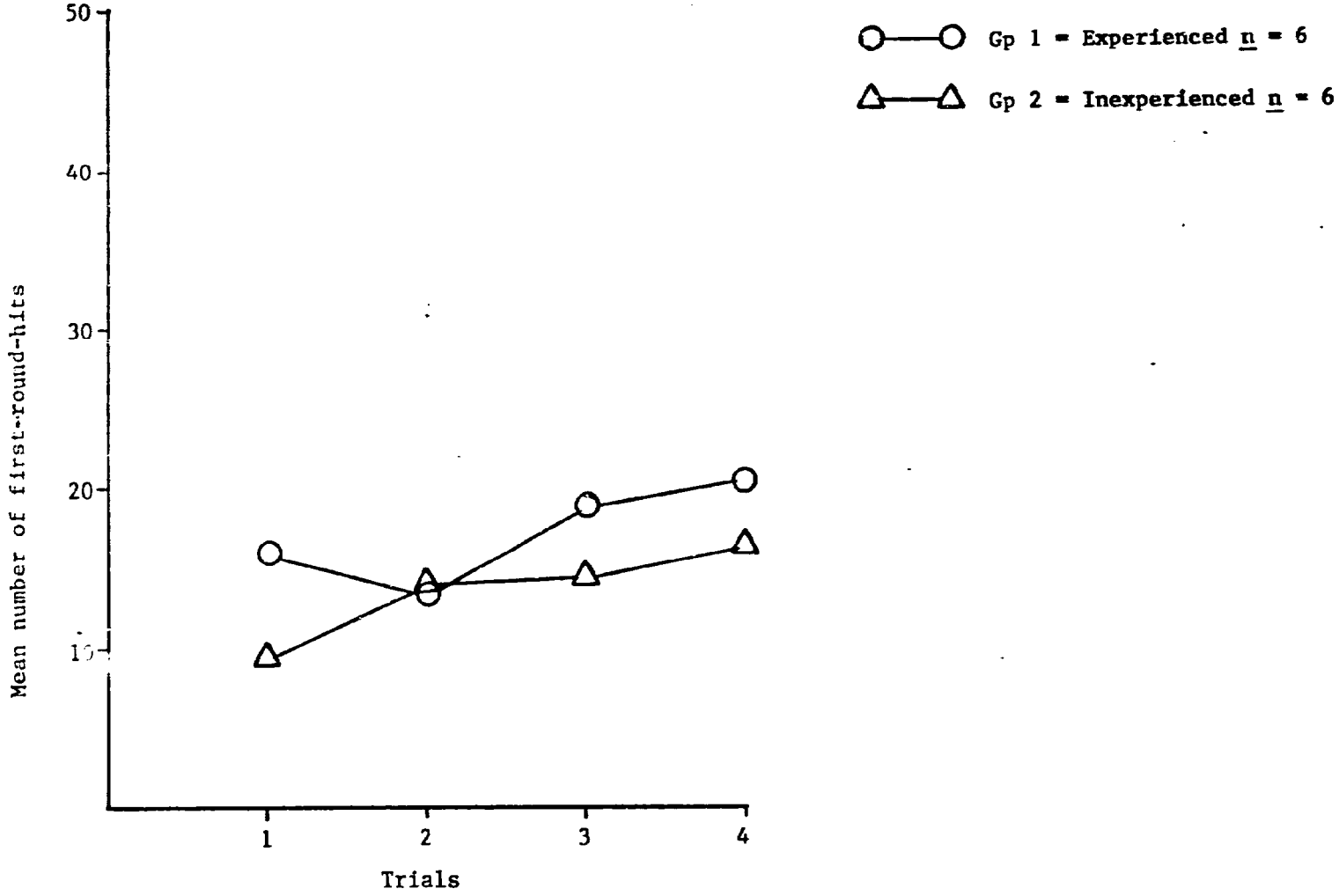

Figure 5. Mean number of first-round-hits per trial for Experiment 2.

significant linear trends for both groups indicate improvement in number of hits and number of first-round-hits over practice trials. This suggests that learning has occurred when subjects used the Battlesight tank gunnery game.

EXPERIMENT 3

Percent hits and percent first-round-hits (accuracy) and the average time to fire (speed) were examined on four different Battlesight game configurations in Experiment 3. The game format was modified from the standard video game to a revised version with the distribution of lives and ammunition into separate games. This modification allowed for the investigation of massed versus distributed practice. Performance was also examined when the target kill zone was reduced.

Method

Subjects. The subjects were 60 soldiers nearing graduation from One Station Unit Training (OSUT) at the 1st Armor Training Brigade, Fort Knox, Kentucky. These soldiers were trained on M60A1 tank gunnery skills (MOS 19E). Subjects were randomly assigned to one of four experimental groups. The experimental groups received practice on the Battlesight under four game configurations: (a) Group 1: Revised Battlesight with the number of lives and ammunition distributed and standard kill zone, (b) Group 2: Standard Battlesight with the standard video game format of massing lives and ammunition and the standard kill zone, (c) Group 3: Revised Battlesight with number of lives and ammunition distributed and a reduced kill zone, and (d) Group 4: Standard Battlesight with the standard video game format and a reduced kill zone. The distribution of lives and ammunition in two of the experimental groups was accomplished by programming each trial into three game blocks. Each game block consisted of one life and 20 rounds of ammunition. The video game version with the massing of three lives and 60 rounds of ammunition existed in the other two experimental groups. Each game block or trial ended when the subject's tank(s) was hit or all ammunition was expended. The trial was then repeated twice.

Apparatus. The Battlesight tank gunnery game was used in Experiment 3. See Experiment 1 for details concerning the characteristics and operation of the Battlesight.

Experimental Design. The experimental design was a 2 x 2 x 3 factorial design with two levels of game format, two levels of kill zone and three repeated trials.

Procedure. Each subject completed a biographical questionnaire. He then listened to taped instructions explaining the procedure on game play before beginning Trial 1. (See Appendixes D and E for transcripts of instructions.) A data collector recorded the measures at the end of each game block or trial. The measures recorded were: (a) elapsed game time (b) total hits and (c) total rounds fired. First-round-hits were tallied during game play.

In Groups 1 and 3, measures were recorded each time the subject's tank was hit or he expended all his ammunition. This signaled the end of game block 1. The game block was repeated two more times for the total trial performance. In Groups 2 and 4, the subject continued playing until he was "killed" three times or expended all ammunition. Measures were subsequently recorded. The subject completed three total trials in one session.

The Battlesight was programmed to include: (a) use of the M32E reticle only, (b) Stage I game play with the Qualified Player Experience Level, (c) no bonus ammo, (d) use of the pseudo tank commander's automatic slew for target acquisition, (e) one to three active threat tanks at one time to engage the subject's tank, and (f) a four-second reload time. These parameters were retained for all groups. The probability of threat tanks engaging and destroying the subject's tank depends upon the elapsed game time and the number of rounds fired by the subject. Because elapsed game time and number of rounds fired were inherently different for Groups 1 and 3 versus Groups 2 and 4, equal probabilities were programmed for all groups to control for these confounding factors. For Groups 1 and 3, the Battlesight was programmed to include only 1 life, 20 rounds of ammunition, and 21 threat tanks per game block while Groups 2 and 4 had 3 lives, 60 rounds of ammunition and 61 threat tanks per trial. A rectangle totally surrounding a threat tank represents the target kill zone. At 100%, the threat tank is destroyed by hitting anywhere within that rectangle. At 50%, the rectangle is decreased by one-half which significantly reduces the area in which a hit destroys a threat target. The kill zone was reduced from 100% in Groups 1 and 2 to 50% in Groups 3 and 4.

Results

Analysis of variance on repeated measures was performed to determine if significant differences existed for game format and kill zone on percent hits, percent first-round-hits, number of rounds of ammunition fired and the average time to fire. Because all subjects fired varying numbers of rounds of ammunition, percent hits and percent first-round-hits were used in the analyses as measures of accuracy. The average time to fire variable was computed by dividing the elapsed game time by the number of rounds of ammunition fired. This variable was used as a measure of speed.

Percent Hits. There was an overall significant effect of kill zone on percent hits (F (1,56) = 19.223; $p<.001$). See Table 5 for summary data. The kill zone by trial interaction was also significant (F (2,112) = 3.183; $p=.045$), which suggested a difference in the learning curves for the two kill zone groups across trials. The linear and quadratic components approached significance, (F (1,56) = 3.263; $p=.076$ and F (1,56) = 3.062; $p=.086$ respectively), which indicated a possible difference in the linear and quadratic components of the trends of the trial means for the kill zone groups, see Figure 6. There was no significant overall game format effect nor was there a significant game format by trial interaction for percent hits. However, the linear component of the game format by trial interaction approached significance (F (1,56) = 3.556; $p=.065$). This result indicated a possible difference in the linear components of the trends of the trial means

Table 5

Mean percent hits for Experiment 3

Group [a]	Trial 1	Trial 2	Trial 3	Trial Mean
1 Revised Video Game Standard Kill Zone				
M	61.13	63.53	71.67	67.00
SD	20.37	20.11	14.93	14.65
2 Standard Video Game Standard Kill Zone				
M	63.87	64.20	65.80	65.00
SD	17.15	15.89	14.95	13.72
3 Revised Video Game Reduced Kill Zone				
M	49.27	55.73	51.53	54.53
SD	14.51	15.03	13.63	8.49
4 Standard Video Game Reduced Kill Zone				
M	51.53	50.60	46.53	50.00
SD	13.59	7.52	9.36	6.45
Total Sample				
M	56.45	58.52	58.88	59.13
SD	17.34	15.98	16.64	13.18

[a] n = 15 per group

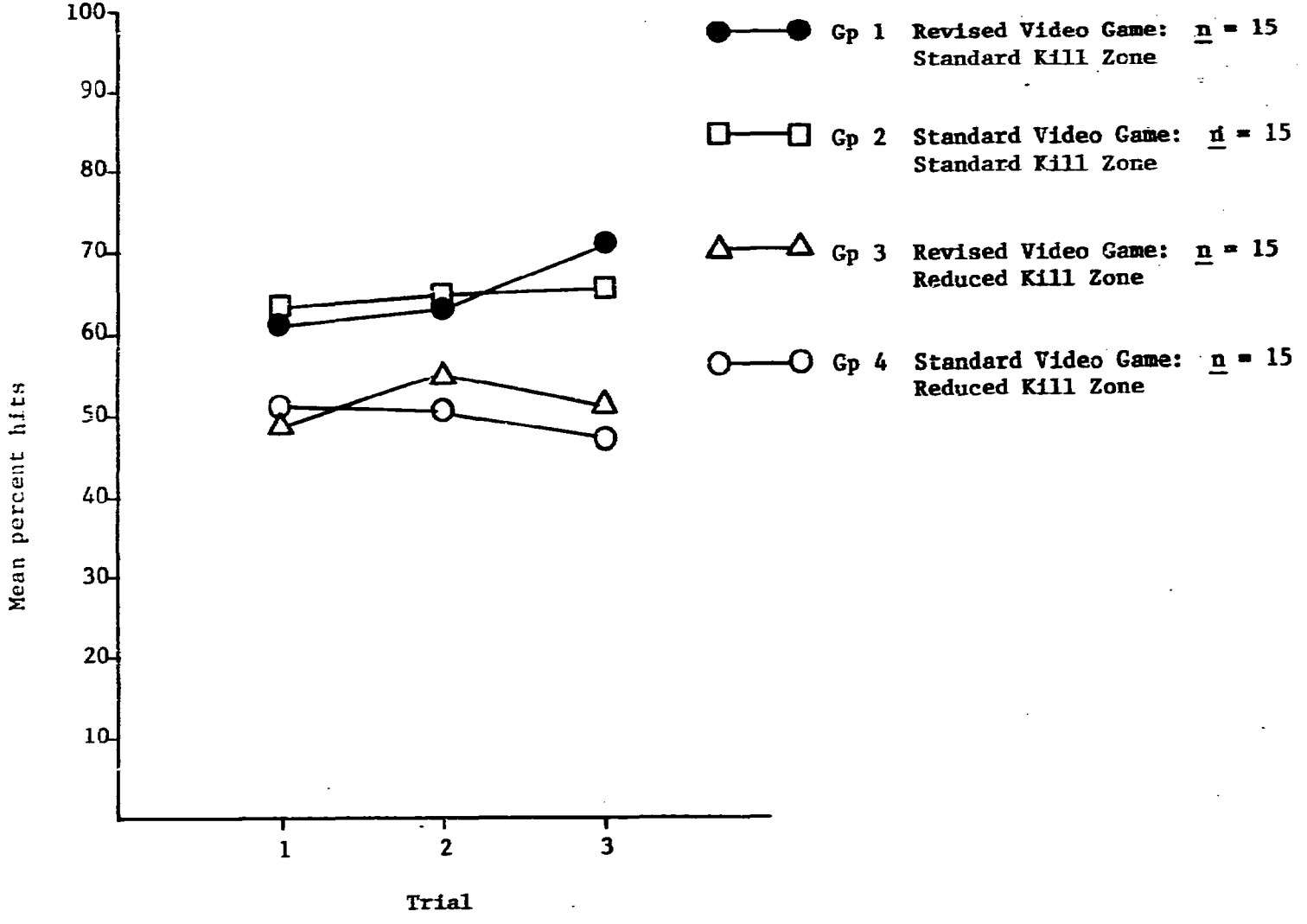

Figure 6. Mean percent hits per trial for Experiment 3.

for the two game format groups, see Figure 6. There was no overall game format by kill zone interaction nor was there an overall trial effect for percent hits.

The simple effects of trial within kill zone were tested. The trial effect for the standard kill zone groups approached significance (F (2,112) = 2.914; p=.058), with a significant positive linear trend in percent hits (F (1,56) = 4.390; p=.041). There was no overall significant trial effect for the reduced kill zone groups. The simple effects of trial within game format were tested. The trial effect for the revised video game groups approached significance (F (2,112) = 2.917; p=.058) with a significant positive linear trend in percent hits (F (1,56) = 4.628; p=.036). There was no significant trial effect or trend for the standard video game groups.

Percent First-Round-Hits. For first-round-hits, an overall significant kill zone effect was found (F (1,56) = 27.997; p<.001). See Table 6 for summary data. The kill zone by trial interaction approached significance (F (2,112) = 2.657; p=.075) with the linear component of the trend of the trial means approaching significance (F (1,56) = 3.645; p=.061). This result indicated a possible difference in the linear components of the trends of the trial means for the two kill zone groups, see Figure 7. No significant overall difference was found for game format or game format by trial interaction. There was no overall game format by kill zone interaction nor was there an overall trial effect for percent first-round-hits.

There were no significant simple effects for trial within kill zone, however, the linear component of the trend of the trial means for the standard kill zone groups approached significance (F (1,56) = 3.620; p=.062).

Rounds of Ammunition Fired. There were no overall significant group differences for the number of rounds fired, however the effect of kill zone approached significance (F (1,56) = 3.796; p=.056). See Table 7 for summary data. The overall trial effect was significant (F (2,112) = 8.876; p<.001) with a significant positive linear trend of trial means (F (1,56) = 16.001; p<.001), see Figure 8.

Average Time to Fire. There were no significant group differences for the average time to fire. See Table 8 for summary data. A significant trial effect was found (F (2,112) = 13.286; p<.001) with a significant negative linear trend in trial means (F (1,56) = 20.089; p<.001), see Figure 9.

Discussion

The purpose of Experiment 3 was to examine subjects' performance under different game formats and different target kill zones. Overall significant group differences were found between the standard kill zone and the reduced kill zone for percent hits and percent first-round-hits. The standard kill zone groups scored a significantly higher percent of overall hits and first-round-hits. This result indicated the dramatic effect on the subjects' accuracy when the target's vulnerable area was reduced. This could be

Table 6

Mean percent first-round-hits for Experiment 3

Group [a]		Trial 1	Trial 2	Trial 3	Trial Mean
1	Revised Video Game Standard Kill Zone				
	M	49.40	51.53	59.33	54.33
	SD	19.66	22.15	20.36	17.39
2	Standard Video Game Standard Kill Zone				
	M	50.80	52.47	52.80	52.53
	SD	18.98	17.41	17.35	14.97
3	Revised Video Game Reduced Kill Zone				
	M	35.93	36.53	35.40	37.20
	SD	12.17	9.63	13.23	7.45
4	Standard Video Game Reduced Kill Zone				
	M	33.87	34.13	29.40	32.47
	SD	15.50	9.60	11.12	8.52
	Total Sample				
	M	42.50	43.67	44.23	44.13
	SD	18.14	17.42	19.83	15.70

[a] n = 15 per group

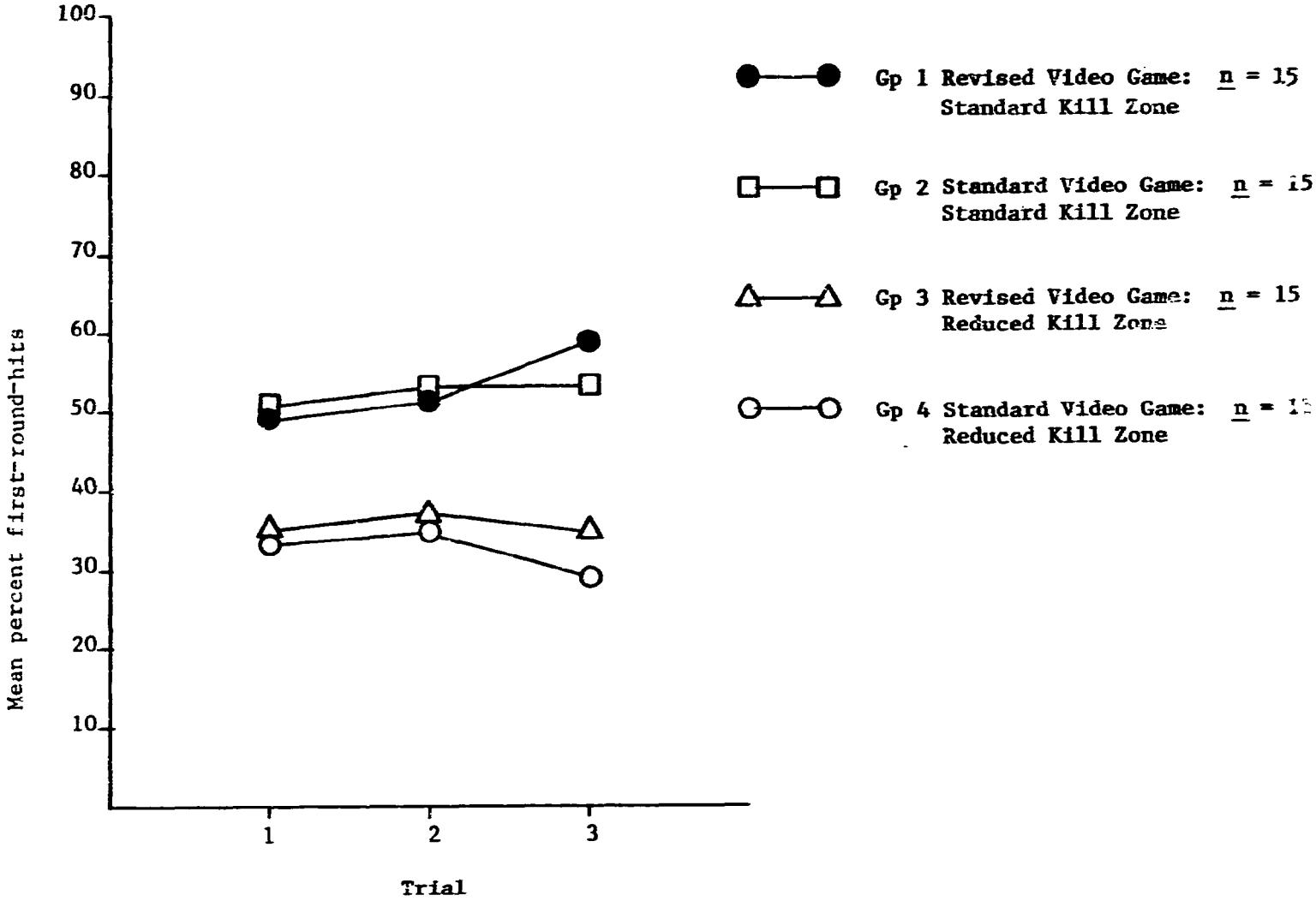

Figure 7. Mean percent first-round-hits per trial for Experiment 3.

Table 7

Mean rounds of ammunition fired for Experiment 3

Group [a]		Trial 1	Trial 2	Trial 3	Trial Mean
1	Revised Video Game Standard Kill Zone				
	M	28.40	33.40	37.40	33.07
	SD	13.90	18.27	10.92	12.19
2	Standard Video Game Standard Kill Zone				
	M	32.13	37.80	45.67	38.53
	SD	17.08	20.04	19.49	14.77
3	Revised Video Game Reduced Kill Zone				
	M	25.67	32.93	31.93	30.18
	SD	13.13	11.23	16.16	10.02
4	Standard Video Game Reduced Kill Zone				
	M	23.27	30.93	34.00	29.40
	SD	15.04	17.91	15.69	10.19
	Total Sample				
	M	27.37	33.77	37.25	32.79
	SD	14.86	16.94	16.33	12.19

[a] n = 15 per group

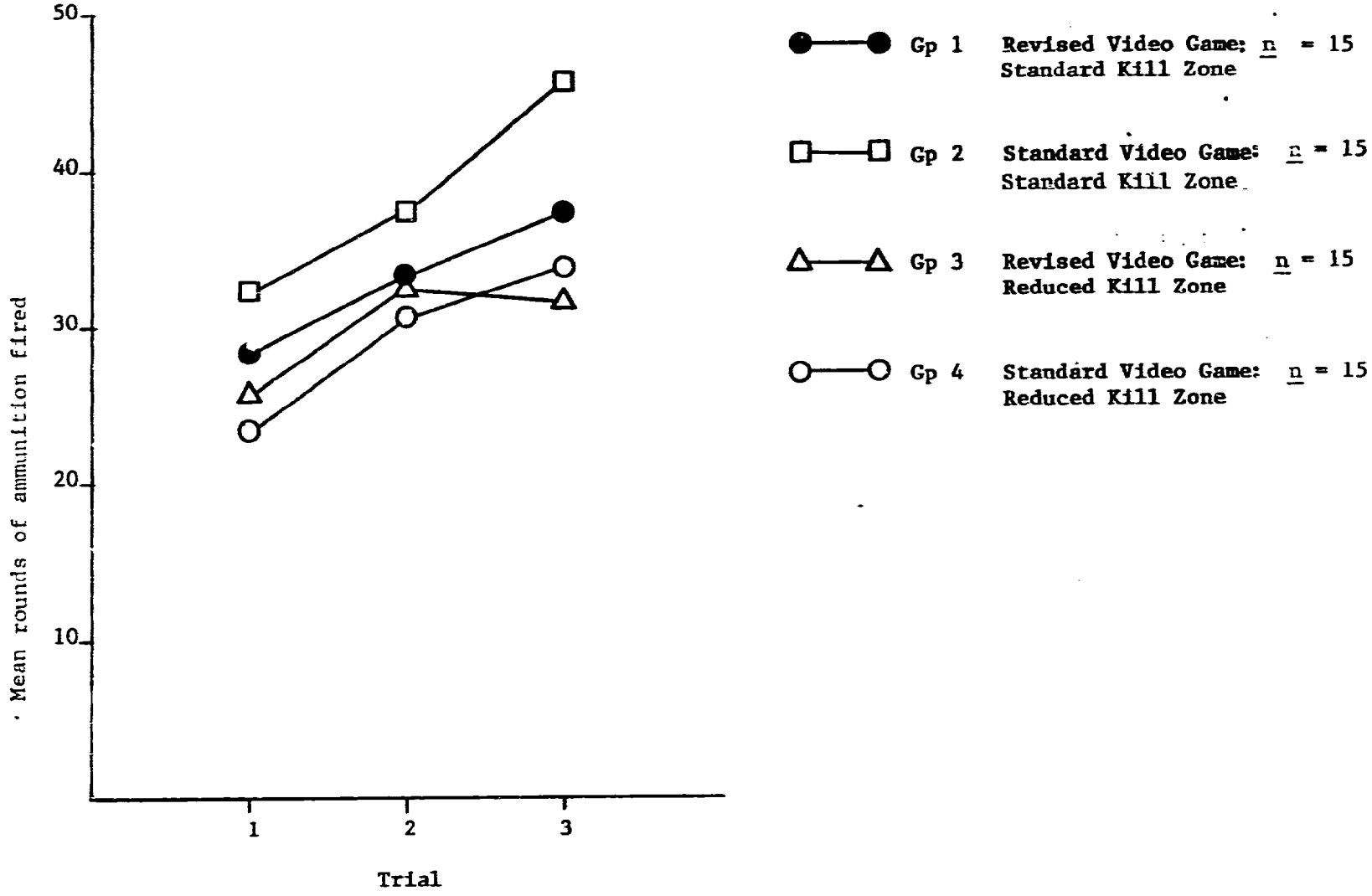

Figure 8. Mean rounds of ammunition fired per trial for Experiment 3.

Table 8

Mean average time to fire for Experiment 3

Group [a]		Trial 1	Trial 2	Trial 3	Trial Mean
1	Revised Video Game Standard Kill Zone				
	M	16.13	14.94	13.73	14.93
	SD	2.80	3.25	2.09	2.21
2	Standard Video Game Standard Kill Zone				
	M	16.54	15.36	14.50	15.47
	SD	5.11	4.40	2.95	3.57
3	Revised Video Game Reduced Kill Zone				
	M	16.73	14.24	13.73	14.89
	SD	6.27	1.66	3.99	2.95
4	Standard Video Game Reduced Kill Zone				
	M	16.54	14.62	12.57	14.57
	SD	5.00	4.01	2.46	3.09
	Total Sample				
	M	16.49	14.79	13.63	14.97
	SD	4.84	3.43	2.97	2.94

Note. Speed of response is in seconds per round fired.

[a] n = 15 per group

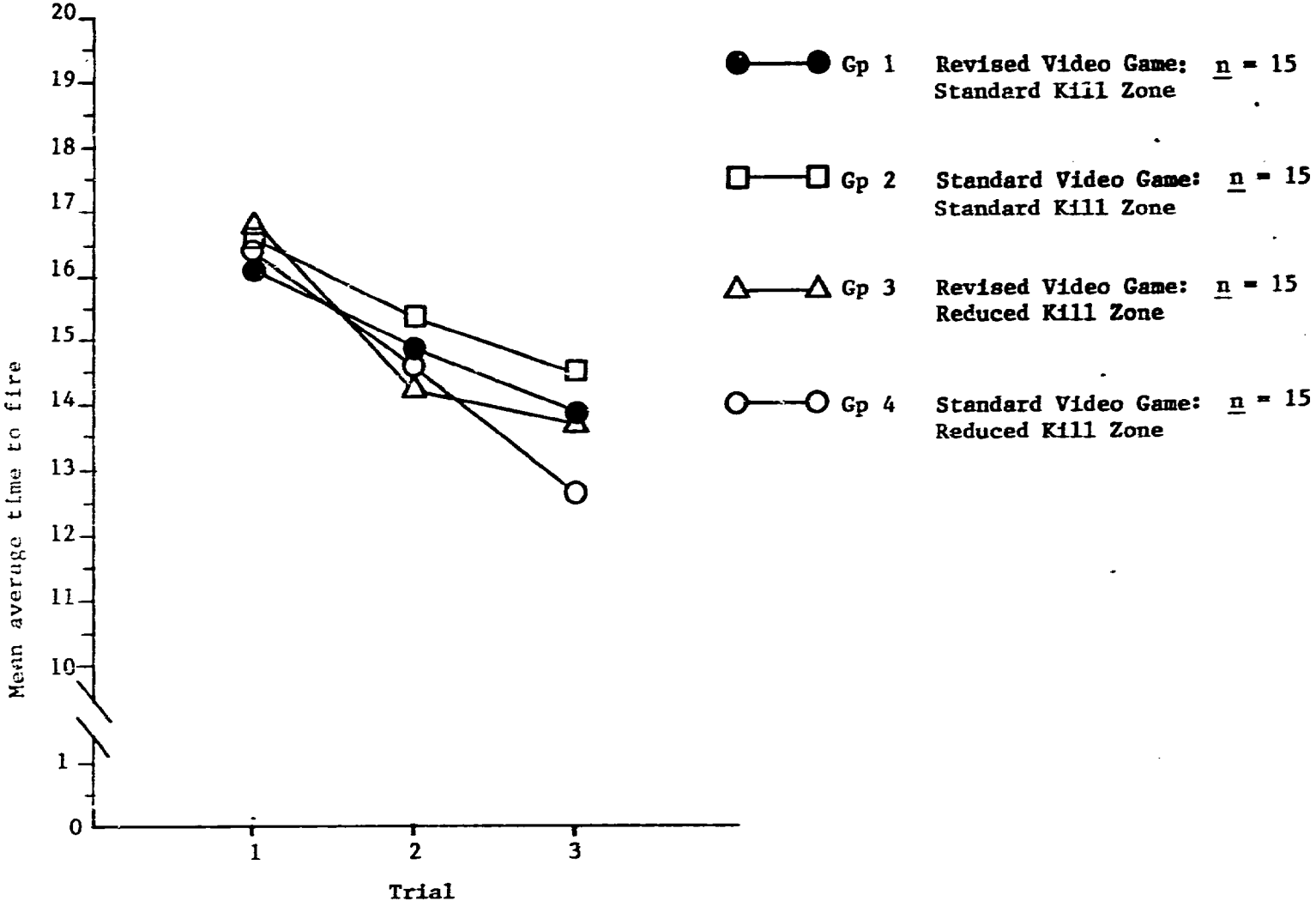

Figure 9. Mean average time to fire per trial for Experiment 3.

accounted for by the characteristic emphasis on speed over accuracy in video games in general. Subjects in all groups used typical video game strategy in destroying targets such as "fast shooting" without using appropriate tracking and gunnery skills. This could be further supported by the significant decrease in the average time to fire over trials in all groups and the increase in number of rounds of ammunition fired. The subjects in the reduced kill zone groups continued to "shoot fast" across trials even though their percent hits and percent first-round-hits suffered. Percent hits and percent first-round-hits in the standard kill zone groups were not affected by this "shoot fast" tactic because the larger kill zone allowed for inappropriate tracking skills and less refined laying of the gun on the target. The learning curves for the kill zone groups demonstrated this difference with a significant positive linear trend in percent hits for the standard kill zone while no trend existed for the reduced kill zone.

While there were no overall significant differences between the two game formats on any of the measures, the shape of the learning curves for the groups differed. The revised video game groups demonstrated a significant positive linear trend in percent hits across trials which indicated an increase in accuracy with practice. The standard video game groups did not significantly increase their percent hits across trials. Both groups significantly decreased their average time to fire indicating that both game format groups became faster at firing rounds across trials. The number of rounds fired also significantly increased across trials for all groups. Although both groups decreased their average time to fire and fired increasingly more rounds of ammunition, only the revised video game groups significantly increased their accuracy with practice. The standard video game groups did not demonstrate this improvement.

The two basic components of skill acquisition are speed and accuracy. Improvement in accuracy along with speed should be evident in an effective part-task trainer of tank gunnery skills. Also, a training device should not reward inappropriate nor careless responses that may become overlearned. This may occur by allowing target kills with an unrealistic kill zone.

GENERAL DISCUSSION

This research addressed questions concerning the training value of the Battlesight tank gunnery game. The first two experiments were designed to determine the shape of the learning curves for two performance measures when using the primary or secondary sights available on the device. The results of both Experiments 1 and 2 indicate relatively strong performance increases. In Experiment 1, subjects continued to improve in number of hits and number of first-round-hits across numerous practice trials when they used the Gunner's primary sight. In Experiment 2, the learning curve indicates improvement in number of hits and number of first-round-hits with practice when subjects used the secondary sight on the Battlesight. In the real training environment, subjects receive minimal training on the secondary sight. Therefore, a training device which could appropriately supplement the amount of training on the secondary sight would be beneficial to an overall training program.

Improvement in performance across practice trials is evident when the subjects used both sights. An equally important question concerns the kind of learning that has occurred. This learning could be explained by two perhaps opposing interpretations. The subjects could be acquiring or improving tank gunnery skills or they could simply be learning the idiosyncracies of the device. This question can only be answered by examining the transfer of training from the Battlesight to either a highly sophisticated gunnery simulator or live fire exercises or both.

The acquisition of speed and accuracy under varying Battlesight game configurations was investigated in Experiment 3. Video game research indicates an emphasis on speed at perhaps the expense of accuracy. This emphasis on speed evolves from the pressure of "shooting first" before being "shot at" in order to continue game play. Performance in the reduced kill zone groups highlights the subjects' continual preoccupation with speed. Their average time to fire significantly decreased while their percent hits and first-round-hits suffered. Other research into the detrimental effects of massed practice can be related to the massing of lives and ammunition in the standard video game format leading to attenuated performance. In order to avoid being "killed" and continue game play in the standard video game format, a subject may emphasize speed over accuracy. This emphasis may lead to improvement in speed at the expense of accuracy. The results of Experiment 3 appear to support this supposition. Subjects in the standard video game format greatly improved their average time to fire and yet concurrently maintained a monotonic level of accuracy. On the other hand, subjects in the revised video game format, with distribution of lives and ammunition into separate and distinct "games", improved not only their average time to fire but also significantly improved their accuracy across practice trials. Perhaps the distribution of lives and ammunition into distinct games forced equivalent emphasis on speed and accuracy.

The results of Experiment 3 suggest the potential benefit of a video game format which allows only one life and a limited amount of ammunition per game play. The capability of programming a decreasing kill zone area would also be beneficial. Reducing the kill zone would require more appropriate tracking procedures and a finer laying of the gun on target for obtaining target kills. The results of this research should not be interpreted as conclusive evidence of the most appropriate video game configuration for ensuring training effectiveness. These results suggest the need for further empirical study.

The specific conditions or situations under which the device would be effective should also be considered. Should the Battlesight be considered a trainer or should it be utilized as a sustainment or remedial device for gunnery skills already acquired? The effectiveness of video games in general as training media may be quite different when compared to their effectiveness as sustainment media. The use of video games for instructional and training purposes is in its infancy with little research to support or negate their value. The motivational quality of video games is quite evident as indicated by their popularity with children and adults alike. However, their instructional and training qualities have yet to be ascertained. Therefore,

the motivational aspects should not obscure the training issues. The frequently expressed idea that "something is better than nothing" should not overshadow the possibility of negative training versus no training. The conclusions concerning the positive or negative training aspects along with the other questions presented herein must ultimately await further research.

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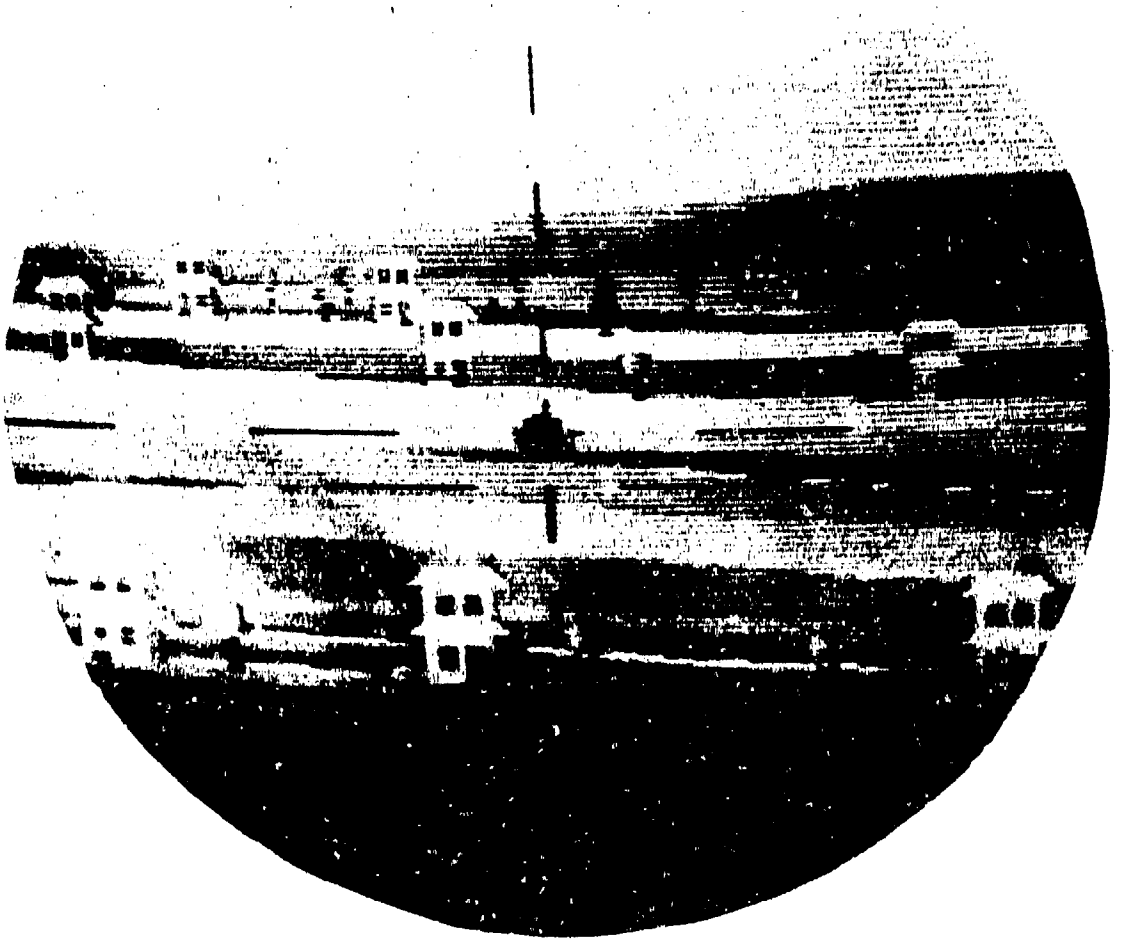
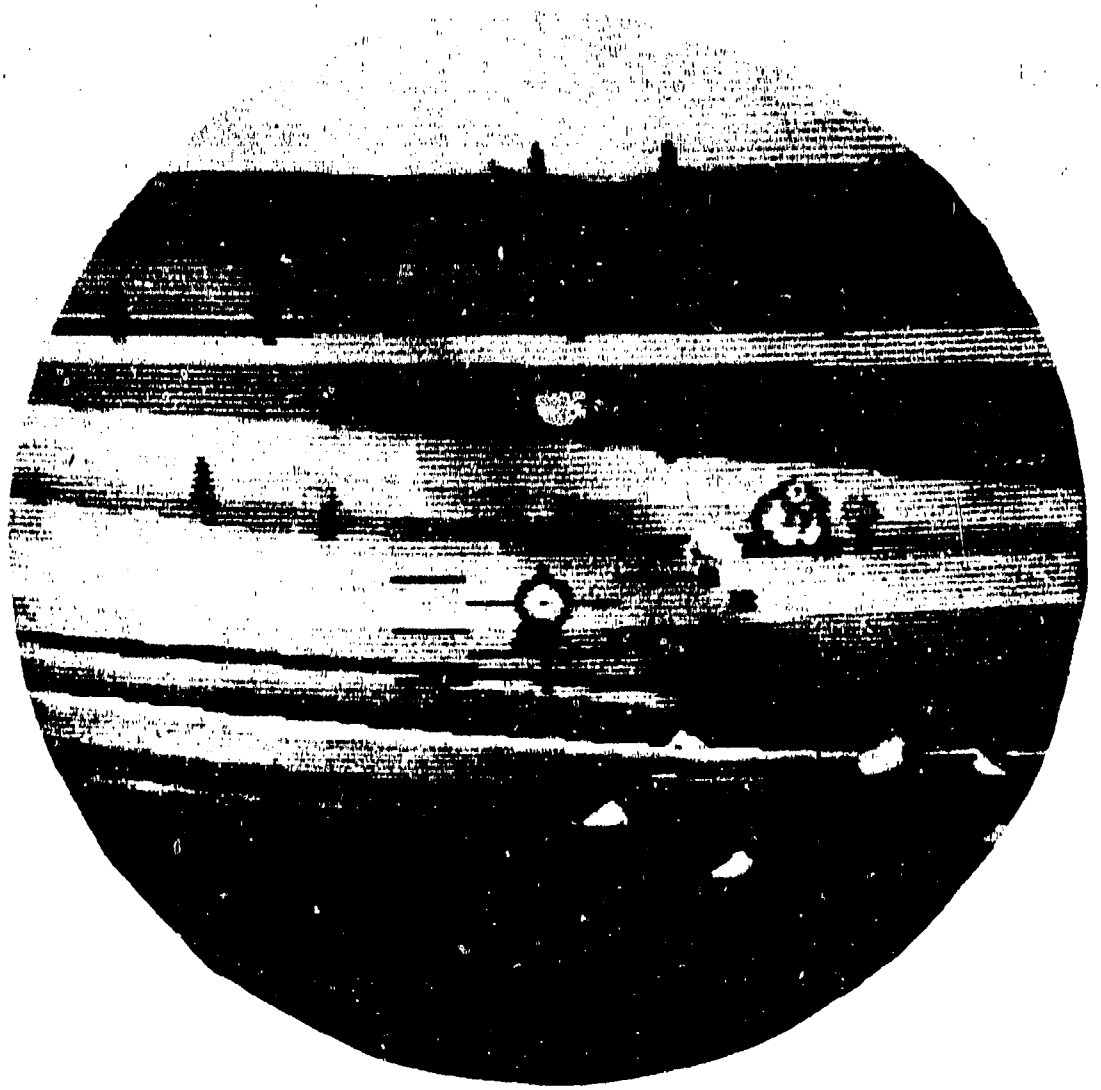
APPENDIX A

EXAMPLE OF GUNNER'S M32E PRIMARY SIGHT ON THE BATTLESIGHT



APPENDIX B

EXAMPLE OF GUNNER'S M105D SECONDARY SIGHT ON THE BATTLESIGHT



APPENDIX C

INSTRUCTIONS TO SUBJECTS IN EXPERIMENT 1 AND EXPERIMENT 2

You will be using the Battlesight to practice your M60A1 target acquisition and engagement skills. Battlesight is an arcade-style device that presents simulated armor threat tanks in a variety of settings. Your objective is to kill as many threat tanks as possible by reacting quickly and accurately which maximizes your score.

You have 100 rounds of SABOT for engaging threat targets in each exercise. Each time you fire a round, your loader will load another round of SABOT, but you must wait for the leader to say "UP" before you fire again or you will receive a penalty or loss of points from your score. The Battlesight is equipped with a pseudo tank commander who issues fire commands. The TC will not be acquiring the target so you must slew the turret to the target and you must press the palm switches in order to slew the turret. It is important for you to listen and follow the directions that the TC gives in the fire command when acquiring the target. For moving targets apply the standard two and a half mil manual lead to obtain target kills. You cannot shoot through buildings or trees and rocks.

The Battlesight is equipped with a special display located to the right of your sight. The display provides information that may be useful to you. Helpful information includes the ammo that is available and target range. Other information includes your score, the time elapsed since you began and the top score. The display also helps you locate targets on the battlefield. As you slew the turret across the terrain, colored dots will appear on the upper portion of the display. You can position the targets in your sight picture by centering the dots in the "V" on the display. A red dot represents a short range target. A yellow dot represents a middle range target and a blue dot represents a long range target. When more than one target appears, engage the most dangerous targets first. Threat tanks will engage you from your front or from adjacent sectors to your right or left. You will not be engaged from the rear. You will continue this exercise until you have fired all 100 rounds of ammo. Once this occurs you will repeat the exercise.

APPENDIX D

INSTRUCTIONS TO GROUP 1 AND GROUP 3 IN EXPERIMENT 3

You will be using the Battlesight to practice your M60A1 target acquisition and engagement skills. Battlesight is an arcade-style device that presents simulated armor threat tanks in a variety of settings. Your objective is to kill as many threat tanks as possible by reacting quickly and accurately before you ar killed..

You have 20 rounds of SABOT for engaging threat targets in each exercise. Each time you fire a round, your loader will load another round of SABOT, but you must wait for the loader to say "UP" before you fire again or you will receive a penalty or loss of points from your score. The Battlesight is equipped with a pseudo tank commander who issues fire commands and slews the turret to the target. For moving targets apply the standard two and a half mil lead to obtain target kills.

The Battlesight is equipped with a special display located to the right of your sight. The display provides information that may be useful to you. Helpful information includes the ammo that is available and target range. The display also helps you locate targets on the battlefield. As the turret slews across the terrain, colored dots will appear on the upper portion of the display. You can position the targets in your sight picture by centering the dots in the "V" on the display. A red dot represents a short range target. A yellow dot represents a middle range target and a blue dot represents a long range target.

You will continue this exercise until you have fired all of your ammo or you are killed. Once this occurs, you will repeat the procedure. However, at the end of each exercise, the screen will display some important information that we will record. Please do not press any buttons to continue until we have recorded all information and indicate that you are to continue.

APPENDIX E

INSTRUCTIONS TO GROUP 2 AND GROUP 4 IN EXPERIMENT 3

You will be using the Battlesight to practice your M60A1 target acquisition and engagement skills. Battlesight is an arcade-style device that presents simulated armor threat tanks in a variety of settings. Your objective is to kill as many threat tanks as possible by reacting quickly and accurately before you are killed three times.

You have 60 rounds of SABOT for engaging threat targets in each exercise. Each time you fire a round, your loader will load another round of SABOT, but you must wait for the loader to say "UP" before you fire again or you will receive a penalty or loss of points from your score. The Battlesight is equipped with a pseudo tank commander who issues fire commands and slews the turret to the target. For moving targets, apply the standard two and a half mil lead to obtain target kills.

The Battlesight is equipped with a special display located to the right of your sight. The display provides information that may be useful to you. Helpful information includes the ammo that is available and target range. The display also helps you locate targets on the battlefield. As the turret slews across the terrain, colored dots will appear on the upper portion of the display. You can position the targets in your sight picture by centering the dots in the "V" on the display. A red dot represents a short range target. A yellow dot represents a middle range target and a blue dot represents a long range target. You will continue this exercise until you have fired all of your ammo or you are killed three times. Once this occurs, you will repeat the procedure. However, at the end of each exercise, the screen will display some important information that we will record. Please do not press any buttons to continue until we have recorded all information and indicate you are to continue.

APPENDIX F

BIOGRAPHICAL QUESTIONNAIRE USED IN EXPERIMENTS 1-3

SUBJECT # _____ DATE _____

1. Total time in service. _____years _____months
2. Grade E-_____ O-_____
3. Age. _____years
4. Educational level. Circle one.

   a. less than 12 years b. high school grad c. GED

   d. technical school e. some college (# of years) _____

   f. college grad (degree) _____ g. other (describe) _____
5. How long have you been in armor? _____years _____months
6. What is your present crew position?_____
7. How long have you been in this crew position? _____years _____months
8. How many times have you fired Table VIII? _____.

   How many times did you qualify? _____

   How long has it been since the last time you fired? _____months
9. When was your last training/sustainment practice? _____ months
10. Have you ever used a table-top tank gunnery training device? Yes No

    If yes, how many times? _____

    If yes, when did you last use the trainer. _____months

    What was the trainer? _____
11. Do you play video games? Yes No

    If yes, how many times? (circle one)

    a. once-twice a week b. more than twice a week

    c. once-twice a month d. more than twice a month

APPENDIX G

BIOGRAPHICAL SUMMARY DATA FOR EXPERIMENTS 1-3

Table G. 1

Biographical Summary Data for Experiment 1

Group[a]	Time/Serv. (months)	Rank*	Age	Time/Armor (months)	Video Game** Experience
1					
M	79.50	4.40	27.50	74.33	4.00
SD	24.17	.55	5.75	25.03	1.55
2					
M	20.67	2.40	21.50	20.67	3.00
SD	13.62	.89	3.94	13.62	1.67
Total Sample					
M	50.08	3.40	24.50	47.50	3.50
SD	35.97	1.26	5.65	33.98	1.62

*Rank:
1 = E-2
2 = E-3
3 = E-4
4 = E-5
5 = E-6

**Video Game Experience:
1 = more than twice a week
2 = once-twice a week
3 = more than twice a month
4 = once-twice a month
5 = never

[a] n = 6 per group

Table G. 2

Biographical Summary Data for Experiment 2

Group[a]	Time/Serv. (months)	Rank*	Age	Time/Armor (months)	Video Game** Experience
1					
M	57.33	3.83	23.00	56.67	3.83
SD	26.80	.98	3.41	26.23	1.17
2					
M	14.67	1.67	22.00	14.67	4.00
SD	9.22	.52	3.58	9.22	1.73
Total Sample					
M	36.00	2.75	22.50	35.67	3.91
SD	39.35	1.36	3.37	28.85	1.38

*Rank:
1 = E-2
2 = E-3
3 = E-4
4 = E-5
5 = E-6

**Video Game Experience:
1 = more than twice a week
2 = once-twice a week
3 = more than twice a month
4 = once-twice a month
5 = never

[a] n = 6 per group

Table G. 3

Biographical Summary Data for Experiment 3

Group[a]	Time/Serv. (months)	Rank*	Age	Time/Armor (months)	Video Game** Experience
1					
M	5.33	1.40	20.47	4.20	3.07
SD	2.35	.63	3.09	1.61	1.71
2					
M	4.87	1.33	19.87	4.67	2.93
SD	2.36	.62	2.03	2.38	1.53
3					
M	8.87	2.20	19.73	5.20	2.20
SD	17.84	2.63	1.75	3.99	1.26
4					
M	13.53	1.80	21.40	6.40	2.93
SD	22.93	1.15	3.44	9.75	1.53

*Rank:
1 = E-1
2 = E-2
3 = E-3

**Video Game Experience:
1 = more than twice a week
2 = once-twice a week
3 = more than twice a month
4 = once-twice a month
5 = never

[a] n = 15 per group